

Bently PERFORMANCE™ Software New Capability and Value for Data Manager® 2000



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Bently PERFORMANCE™ provides an opportunity for Data Manager® 2000 users to benefit from online monitoring and analysis of thermodynamic performance. The system uses the Data Manager® 2000 Data Acquisition and Display modules to provide information on the current performance and historical trends of machines. Data Manager® 2000 and Bently PERFORMANCE™ provide total integration between vibration, rotor position, other machinery critical variables, process variables, and performance calculations. As a result, users gain valuable information to provide detailed understanding of the condition of machines in a combined rotor dynamic and thermodynamic format.

Bently PERFORMANCE™ is much more than a software program. Effective performance management of machinery assets requires a carefully designed system that combines high quality software and system engineering – from sensors through to the thermodynamic calculations that provide performance information. Bently

PERFORMANCE™ benefits from the system engineering that makes Data Manager® 2000 an accurate and reliable source of machinery information.

A Bently PERFORMANCE™ solution provides all of the extra engineering required to ensure that the available thermodynamic performance information meets stringent requirements for *accuracy and repeatability*. We do this through our Engineering Services organization which evaluates your

requirements for
performance
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BENTLY

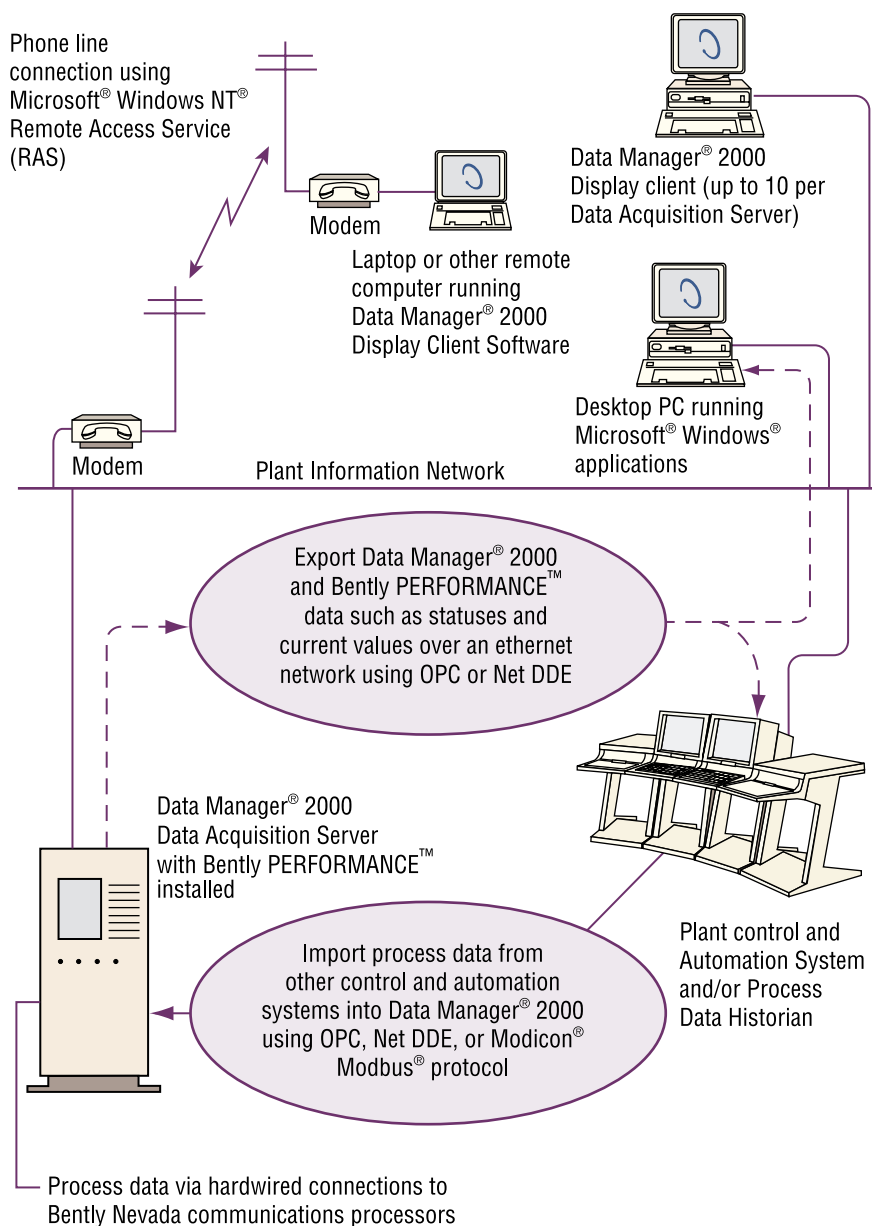
Performance™

designs a
high quality system,
and provides a fully installed, configured,
and optimized solution.

What Is Different About Bently PERFORMANCE™?

Bently PERFORMANCE™ was designed by Bently Nevada Corporation's (BNC's) engineers to provide a totally up-to-date solution for continuous online thermodynamic performance calculations and monitoring. We wanted to take full advantage of the

proven and robust qualities of Data Manager® 2000. Thousands of users of Data Manager® 2000 and Bently Nevada 3300 Series and 3500 Series monitoring systems already have an extremely effective system for protecting their machinery and collecting *rotor dynamic* data. BNC's experienced Engineering Services engineers have extensive knowledge of the design and operating characteristics of the rotating machinery assets and fixed assets that are included in plant inventories. All over the world, our Machinery Diagnostic Services engineers are working on every type of rotating and reciprocating machinery found in typical refineries, petrochemical plants, and power plants. Bently Nevada Corporation has a unique knowledge-base of machinery behavior, especially the interaction between rotor dynamic and thermodynamic performance. Bently PERFORMANCE™ provides a tightly integrated system, which builds a comprehensive database of *thermodynamic* performance information that can be *correlated* with *vibration and position* information in order to provide enhanced Asset Management. Of course, Bently PERFORMANCE™ is designed to be totally compatible with other Bently Nevada Corporation products, including Machine Condition Manager® 2000 today, and System 1™ in the future.



System architecture showing integration with Data Manager® 2000.

Bently PERFORMANCE™ – System Components and Modules

1. Asset Management Evaluation

This module represents the first component of any Bently PERFORMANCE™ solution. Bently Nevada Corporation's Engineering Services personnel conduct the Asset Management Evaluation. Working with your engineers, we carry out a detailed audit of all plant assets. Currently available

measurements and sensors are evaluated, machine types are documented, and review of the performance information you require is conducted with your plant Engineering and Operations management. Then, a detailed report is provided which identifies the total system requirements and proposes a project scope. Cost-Benefit Analysis is provided, identifying and categorizing assets that are included in the solution, on a prioritized basis.

The Asset Management Evaluation will vary in scope and cost for different projects. For example, when a new plant is in the design stage, the focus will be on ensuring that necessary information for performance management is included in the global plant information system. When an upgrade of an existing facility is planned, additional engineering is required, ensuring that all of the necessary machinery measurements are available – with the necessary grade of sensors located in the required positions for each category of machine. Integration engineering priorities are also high, to ensure that the Bently PERFORMANCE™ and Data Manager® 2000 systems integrate effectively with existing plant information systems.

2. Bently PERFORMANCE™ Software Modules

Bently PERFORMANCE™ software modules provide OLE / NetDDE communications with Data Manager® 2000, and a pre-engineered set of calculation templates for the machine types is included in the system. The templates have been developed by BNC using a special application of Microsoft® Excel 2000. This provides a robust, industry-standard platform with excellent integration with other Microsoft® Office 2000 applications. The PERFORMANCE™ calculation modules use numerous BNC-developed software functions (add-ins) that are unique to Bently PERFORMANCE™.

Available standard machine modules in Bently PERFORMANCE™ Release 1 include:

- Gas Turbines,
- Compressors,
- Pumps,
- Steam Turbines,
- Generators.

All calculations are performed in SI units; input measurements and

performance calculation results can be accommodated in U.S. Customary or SI units.

Gas Turbine Performance Module.

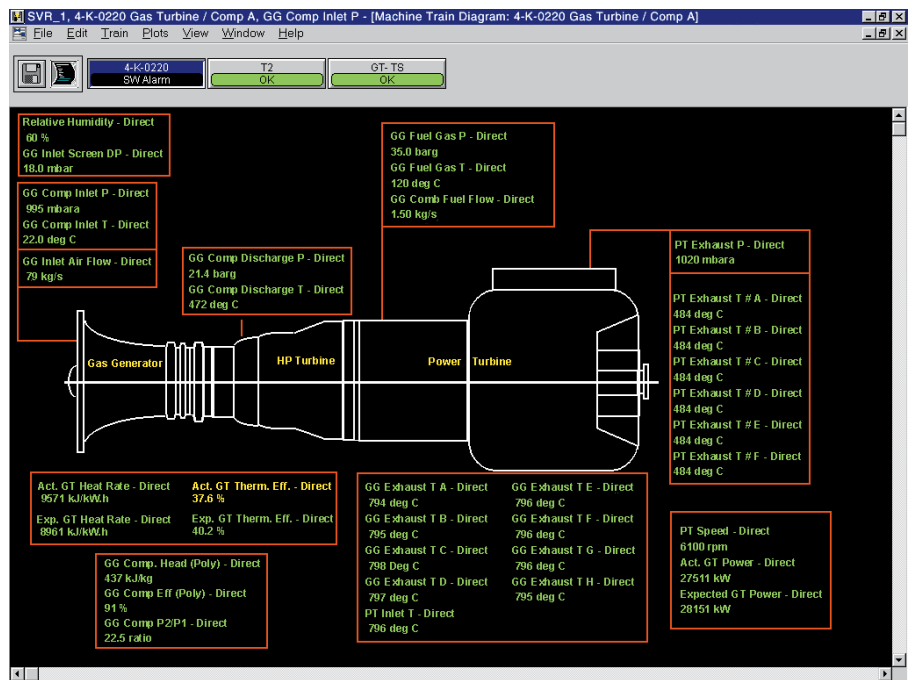
This module provides accurate calculation of Gas Turbine performance indicators, including overall

- Thermal Efficiency,
- Heat Rate,
- Compressor Section Polytropic Efficiency,
- and Turbine Section Isentropic Efficiency and Power.

Both single-shaft and double-shaft engines are supported, with inlet air cooling/heating and steam/water injection where appropriate. All calculated parameters are referenced to a full performance database for the specific machine type. Expected performance data at site conditions is compared with current performance, and deviations are quantified. Performance loss due to compressor, combustion system, and turbine degradation can be readily identified during extended periods of operation. The financial impact of reduced performance can be monitored directly, and the primary source of performance loss identified.

Compressor Performance Module.

This module is available in versions suitable for single- and multi-stage centrifugal compressors, axial compressors, and blowers. Gas calculations are performed using industry-accepted computational methods, with real gas equations of state for single gases and complex gas mixtures. Compressors with side-load and side-stream flows can be accommodated with section performance calculations as required. Design performance data and maps are used to create a database from which expected performance is calculated, and then compared with



Typical machine train diagram with performance summary.

actual performance. Available compressor performance indicators are Isentropic and Polytropic Head, Discharge Pressure, and Pressure Ratio for variable speed and inlet volume flow. Isentropic and Polytropic Efficiency, Gas (internal) Power, and Shaft Power are also calculated for current operating conditions, and compared to expected values.

Pump Performance Module.

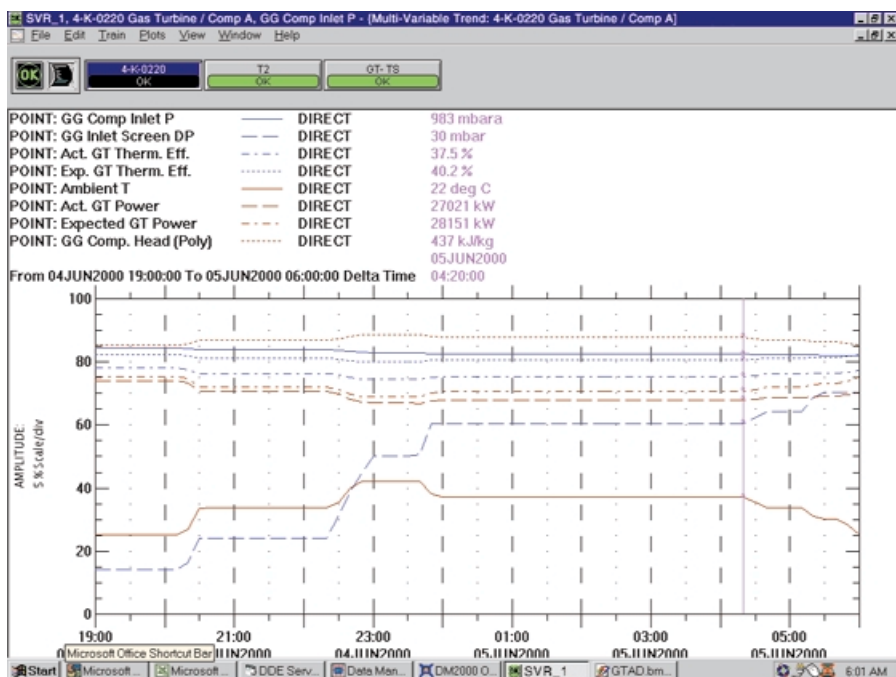
This module is a practical and useful tool for determining off-design performance due to pump degradation. Each pump's design performance characteristic curves for power, head, efficiency, and flow are entered into the database for reference by the module. The actual performance of the pump is calculated from operational data and compared to the expected performance. Design data and current calculations are used to provide continuous assessment of the pump's Net Positive Suction Head (NPSH) required and NPSH operating margin.

Steam Turbine Performance Module.

This module provides an accurate assessment of turbine performance under varying operating conditions. Most steam turbine categories can be accommodated, including variable-speed mechanical drive machines, with or without extraction, and power generation machines, with or without re-heat. Multi-casing turbine sets with tandem or cross-compound arrangements are included. Key performance parameters such as heat rate, specific steam consumption, enthalpy drop efficiency, and overall thermal efficiency are calculated. Trend analysis of calculated parameters, along with trends of acquired process parameters, enable the source of performance deviations to be identified.

Generator Performance Module.

This module is available in versions suited to air-cooled and hydrogen-cooled machines. Design data is used to construct a database from which expected efficiency is calculated at different operating conditions (for



Typical multi-variable trend plot.

example, megawatt load, megaVAR load, power factor, and stator coolant temperature). For machines with water-air or water-gas coolers, gas-side and water-side temperature and flow measurements are used to calculate cooler effectiveness. For machines with water-cooled stator windings, calculation of cooling effectiveness is carried out. For all types of generators, measured load information is used with efficiency calculations and a heat flow balance to provide an accurate calculation of actual shaft power absorbed by the

machine. This calculation is also used in energy balance calculations for the Gas Turbine or Steam Turbine driver.


3. Performance Engineering Training

After commissioning and optimizing the Bently PERFORMANCE™ system, users will be fully trained in its maintenance and operation. Effective application of the performance information requires user training in order to achieve the best possible Return On Investment (ROI). Training requirements vary, and the Performance Training

Module is designed to be flexible in content to suit individual customer requirements.

Technical Support Plan

The Technical Support Plan for Bently PERFORMANCE™ software provides technical support for the Data Manager® 2000 and Bently PERFORMANCE™ systems. Existing Data Manager® 2000 users with Technical Support Agreements can upgrade to a full Bently PERFORMANCE™ Technical Support Module when Bently PERFORMANCE™ is purchased as an addition to an existing Data Manager® 2000 system. This extended Technical Support Module is available in versions for single and multiple Data Acquisition Servers for durations of one to five years. A one-year Technical Support Plan is included in the cost of the Bently PERFORMANCE™ system. Benefits include access to Bently Nevada Corporation's Technical Support Hot Line and updates of software for the purchased version, which are introduced during the period of validity of the Technical Support Module.

For more information about Bently PERFORMANCE™, contact your local Bently Nevada Corporation sales professional, or visit our website at www.bently.com. 

ASME Publishes Tribute to Walter R. Evans

Our First Quarter 2000 ORBIT featured a tribute to Walter Richard Evans, inventor of the Root Locus Method for designing and analyzing automatic control systems. This method is strongly promoted by Bently Nevada as an indispensable tool for analyzing any feedback control system, whether electrical or mechanical, and we often use it to

analyze rotor dynamic systems.

As testimony to Mr. Evans' remarkable career and contributions, ASME International also recently published an excellent tribute to him in their Summer 2000 DSC Division Newsletter. The tribute, written by Dr. Robert H. Cannon, Jr., is highly recommended to our readers. It contains additional detail

regarding Mr. Evans' life and accomplishments. Both the ORBIT and ASME articles can be conveniently accessed on our website at www.bently.com (follow the links to the First and Second Quarter 2000 issues of ORBIT respectively). You can also request a printed copy of these articles by writing to us. 